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Patents Form 1/77

Patents Act 1977
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08MAY03 E805524-1 C93534
P01/7700 0.00-0310482.5

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

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1. Your reference

CORE DOG

2. Patent application number
(The Patent Office will fill in this part)

07 MAY 2003 0310482.5

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

ZERO SHIFT LTD
THE COPLAN BUILDING
MICHIGAN DRIVE, TONGWELL
MILTON KEYNES
MK15 8HQ U.K.

08268863001
Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

SHAFT ENGAGEMENT MECHANISM

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

AS ABOVE

Patents ADP number *(if you know it)*

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

Patents Form 1/77

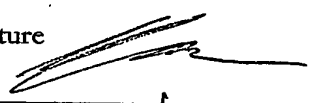
9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	1 (FORM 7/77)
Description	7
Claim(s)	Nil
Abstract	Nil
Drawing(s)	4

10. If you are also filing any of the following, state how many against each item.

Priority documents	Nil
Translations of priority documents	Nil
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	NO form 7/77 INCLUDED

11. I/We request the grant of a patent on the basis of this application.

Signature  Date 7/5/03

12. Name and daytime telephone number of person to contact in the United Kingdom William Martin 07817 376 339

01908 617 469

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Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.*

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'Shaft Engagement Mechanism'

The present invention relates to an improved shaft engagement mechanism. More specifically the present invention relates to improvements to a dog engagement system. Dog engagement systems are mainly used on racing car gearboxes to engage and disengage gear. The present application applies to any application where rotational drive may be coupled and or decoupled to a gear, shaft or such like.

With conventional 'Dog-Engagement' systems in gearboxes it is necessary to interrupt the supply of power to the gearbox to enable a dog-ring to be disengaged from the presently engaged gear wheel in order to shift ratios. Conventional dog engagement systems also have significant backlash. It is one object of the present invention to substantially overcome these deficiencies.

In accordance with the present invention there is provided an improved dog-type engagement mechanism whereby the conventional dog ring is replaced with two interspaced and independently slidable assemblies (dog sets). The pair of independently operated dog sets comprising a clockwise set and an anticlockwise set of dogs. Each dog is only capable of transmitting torque in one direction due to one face of the dog being ramped to cause unlocking in the rotational direction opposing the direction of power transmission (providing only one set of the pair is engaged).

When both sets of a pair are engaged, the power may be transmitted in either direction without unlocking. Backlash is virtually eliminated when both sets are engaged.

Each assembly set comprises of three bars each independently keyed to a shaft with a slide fit in the keyway. The three bars of each set are fixed to a bracket such as a ring such that the three bars and ring form one assembly. The two assemblies that form a pair of dog sets. Each assembled set slides axially along

the shaft into and out of engagement independently of the other dog set assembly of that pair. The three bars of an assembly slide in unison.

The sliding of the pairs can be achieved with two actuators, one for each set or with a single actuator connected to either one or two resiliently deformable means.

In one form of the invention, the or each resiliently deformable means is provided in the form of one or more springs. In a specific embodiment of the invention, the or each resiliently deformable means is provided in the form of one or more disc springs such that moving the actuator will either move both sets or move one dog set and spring load the second set to follow. The loaded set will not slide away from engagement until the load is removed (due to the engagement of the next ratio). The ramped faces opposite the drive face of each dog provide a failsafe to unlock.

Preferably, the actuation is by fork whereby each of two spiral disc springs are rotatably connected to either of the two dog sets such that they are able to axially slide independently. Movement of the fork moves the disc springs of both dog sets. Moving the fork head towards the mating dogs would engage as per a conventional system.

Preferably still, the actuator assembly further comprises a slidable selector rod, and the first and second actuator elements are provided in the form of first and second springs, wherein the selector rod is provided substantially parallel to the shaft, with the selector fork provided about the selector rod, the resiliently deformable means being provided within the selector.

In one embodiment where the system is used to engage and disengage two drives on one shaft such as in a gearbox, the dog pairs are double ended such that the two ends of a dog set have opposite faced dogs at either end. A dog set that can transmit clockwise torque to the gear adjacent to its first end will transmit anticlockwise torque at the opposite end adjacent to the second gear. If a pair is adjacent to the first gear (engaged) only one set is transmitting torque at any time.

It is possible to slide the unloaded set axially along the shaft to the second gear thus instigating a ratio change. The second set can then follow to create full lock in both directions in the new gear.

The configuration allows two gear ratios to be engaged in the same torque direction simultaneously for an instant during a shift whilst eliminating the possibility of drivetrain lockup.

The configuration whereby the dogs are close to the shaft provides direct transmission of power between the shaft and the gear without the need for significant cantilever or offset radial distance of the loaded areas thus reducing potential for structural failure.

In a motor vehicle application for example, the dog sets are situated between two ratios such that they can slide into engagement of either ratio. As the ends of each pair of dog set face each gear, one dog set is dedicated to acceleration while the other set is dedicated to engine braking. Further along the shaft at the opposite end of each dog set as the dog sets engage with the next gear, the directions are reversed such that the opposite end of the engine braking set of first gear is the acceleration set of second gear. During an accelerating up shift the fork head is moved from 1st gear to 2nd gear. The engine braking set in first gear is unloaded and disengages allowing that dog set to slide across into second gear and engaging the accelerating dogs of second gear. This causes or allows the disengagement of the acceleration dogs of first gear so that the second dog set can slide into second gear providing engine braking and preventing backlash in second gear.

An up shift without torque interrupt is achieved by sliding the engine braking set of the lower gear out of engagement, the other end of which is the acceleration set of the higher gear. The engagement of which then causes or allows the disengagement of the other dog set which was providing acceleration of the lower gear, and will provide engine braking of the higher gear once the slide is complete.

Similarly, uninterrupted engine braking down shifts require the engagement means to travel from the higher gear to the lower gear. The acceleration set of second gear is unloaded during engine braking and will unlock. The engine braking set of the lower ratio can then be engaged. This will cause or allow the engine braking set of the higher gear to disengage. The acceleration set of the lower gear can then be engaged. The lower gear is then fully engaged in both directions without backlash.

Kick-down shifts are achieved with a minor torque interrupt to allow disengagement prior to the shift.

Another embodiment is that both dog sets are controlled by a single disc spring. If a single spring is used the spring rotates in the fork. With two springs there is no need for the spring to rotate providing the connection between the dog set and the ring allows rotation of the dog set.

Another embodiment is for the use of dovetail shaped keyways thus eliminating the need for the rings.

Brief Description of the Drawings

The present invention will now be described by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of the double dog set sliding interlock assembly in accordance with the embodiment.

Figure 2 is a perspective view of a typical mating dog set on the side of a gear wheel.

Figure 3 is a sectional view of the assembly including the fork and spiral disc springs.

Figure 4 shows a spiral disc spring.

In Figures 1 to 4 there is shown elements of transmission system 10. The transmission system 10 comprises a shaft 12, and a selector assembly 16. As can best be seen in Figure 3, rotatably provided about shaft 12 are first and second gear wheels 18 and 20. The gear wheels 18 and 20 respectively engage third and fourth gear wheels 22 and 24 (not shown) fixedly provided about shaft 14 (not shown), to form first and second gear wheel pairs 26 and 28.

Rotational power may be transferred to or from shaft 12 by way of either of the gear wheel pairs 26 or 28, as determined by positioning of the selector assembly 16.

The selector assembly 16 comprises first and second recess rings 30 and 32, first and second dog sets 34 and 36, a selector rod 38 and an actuator assembly in the form of a fork assembly 40.

The first recess ring 30 is fixed into gear wheel 18 and the second recess ring 32 is fixed into gear wheel 20, as can best be seen in Figure 3.

Interposed between the recess rings 30 and 32 are the first and second dog sets 34 and 36. Provided about a portion of shaft 12 interposed between the first and second gear wheels 18 and 20 are a series of external keyways 42, as can best be seen in Figure 3. The keyways 42 engage corresponding keys 44 on each of the dog sets 34 and 36, such that the dog sets 34 and 36 are independently and axially slidable along shaft 12, whilst rotating in conjunction therewith.

The selector rod 38 is provided parallel to shaft 12 and adjacent thereto. Provided about the selector rod 38 is the fork assembly 40, fork 46, and two springs, 48 and 50, as can best be seen in Figure 3.

The inner edges of springs 48 and 50 are fixed to the dog sets 34 and 36 such that the springs rotate with the shaft and slide with the dog sets. The outer edges of the springs are held and forced to slide with the fork by guide 47 such that it allows the springs to rotate with the shaft.

Referring specifically to Figure 1, the first dog set 34 comprises three bars 60 that are held together by fixings 64 to connector ring 35. The three bars 62 of dog set 36 are held together with fixings 66 to connector ring 37. The arrangement is such that dog sets 34 and 36 can slide independently of each other. Ring 37 slides over (but is not connected to) dog set 34. Ring 35 slides over (but is not connected to) dog set 36.

Equidistantly circumferentially spaced about each end of each bar of each dog set are three unlocking ramps 68 and three engagement faces 75.

As can best be seen in figure 2 the recess sets 30 and 32 each has three dogs 73, equidistantly spaced about the circumference. When the fork causes the dog sets to slide towards the recess sets 30 or 32, the dog faces 75 lock against the dogs 73 thus causing power transmission.

For power to be transmitted in both directions of rotation in either of gear ratio pairs 26 or 28, both dog sets 34 and 36 must be engaged with the gear dogs 73. Power can only be transmitted in one direction at a time allowing the possibility of sliding the fork 46 to cause disengagement of one set at all times (the other set will not engage due to spring pressure due to the power transmission load on face 75). The rotational direction of power transmission at the end of dog set 34 is matched by the direction of power at the opposing end of dog set 36 and vice versa. This allows the unloaded set to move into engagement with the next ratio while the existing ratio is still transmitting power. The subsequent overdrive causes relative counter rotation of the dog set of the previous ratio whereupon both the spiral disc spring and or the ramps 68 cause unlocking of the previously engaged ratio. This in turn allows the second dog set to engage the new ratio for power transmission in both directions with minimum backlash.

As the first selector spring 48 causes the first dog set 34 to slide axially along shaft 12, the faces 75 engage the arcuate recesses 72 of the second recess set 32. The engagement surfaces 75 then begin to drive the second gear wheel 20, and energy is transmitted from the shaft 12 to or from the output shaft 14 by way of the second gear wheel pair 28.

As this occurs, the faces 75 of the second dog set 36 cease to be loaded. Thus, the spring 50 is released, causing the second selector spring 50 to slide axially along the shaft 12, and thus the second dog set 36 to slide axially along shaft 12 thereby completing the disengagement of the first gear wheel 18 therefrom. The second dog set 36 continues to slide along the input shaft until the faces 75 engage the arcuate recesses 72 of the second recess ring 32, thereby completing the engagement of the second gear wheel 20 with shaft 12. Power may now be transmitted in either direction.

Modifications and variations such as would be apparent to the skilled addressee are considered to fall within the scope of the present invention.

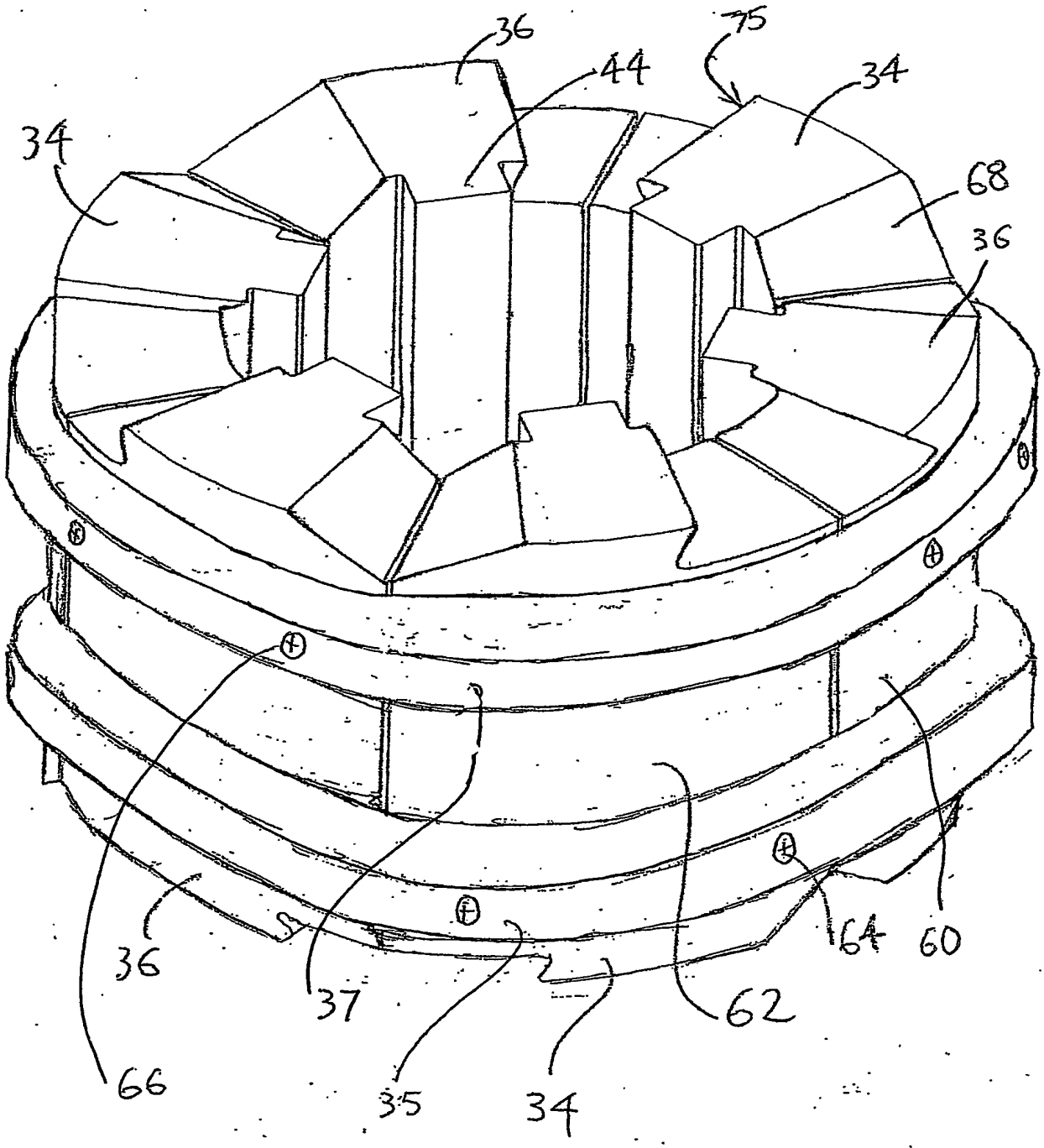

Fig 1

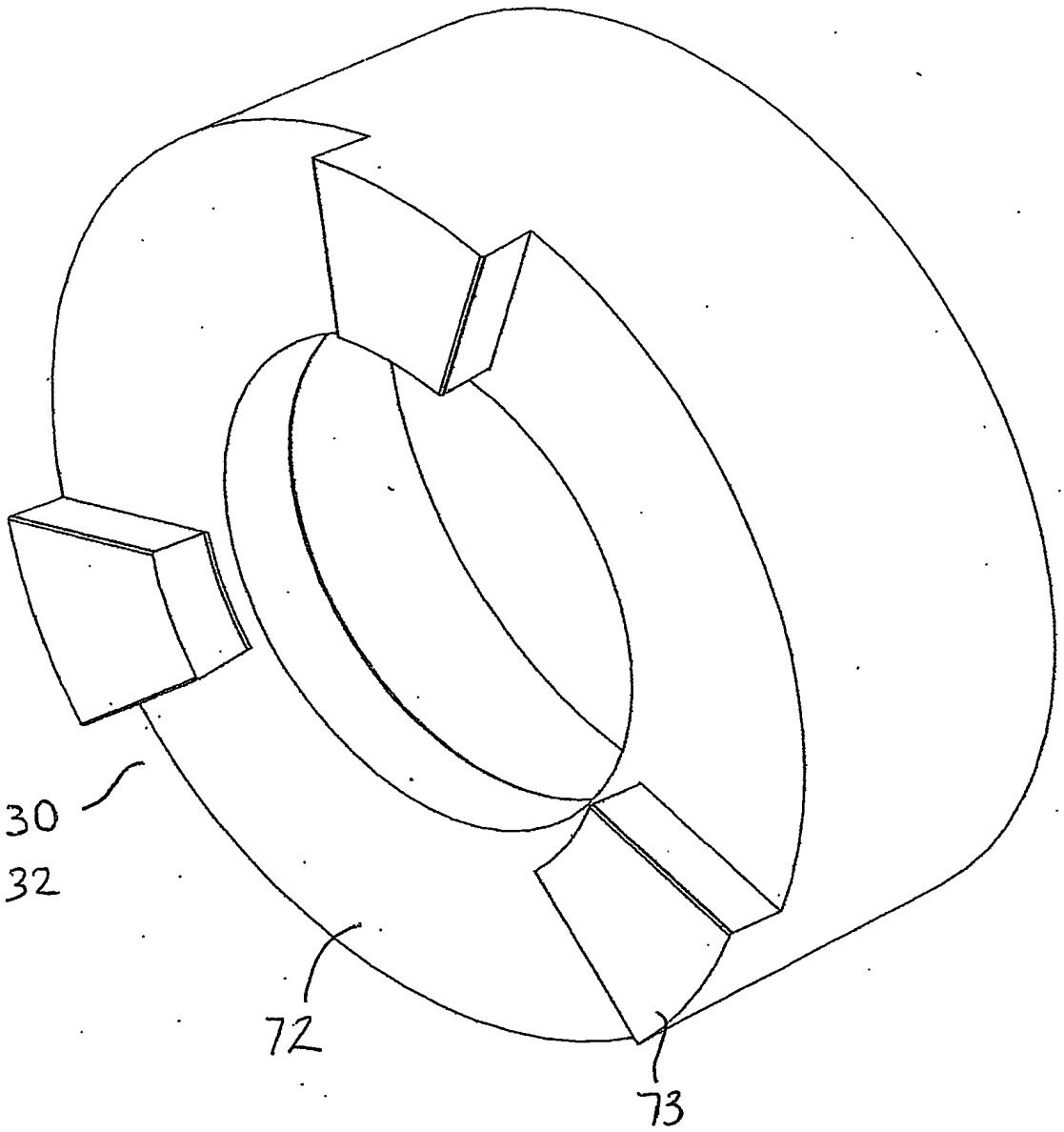

Fig 2

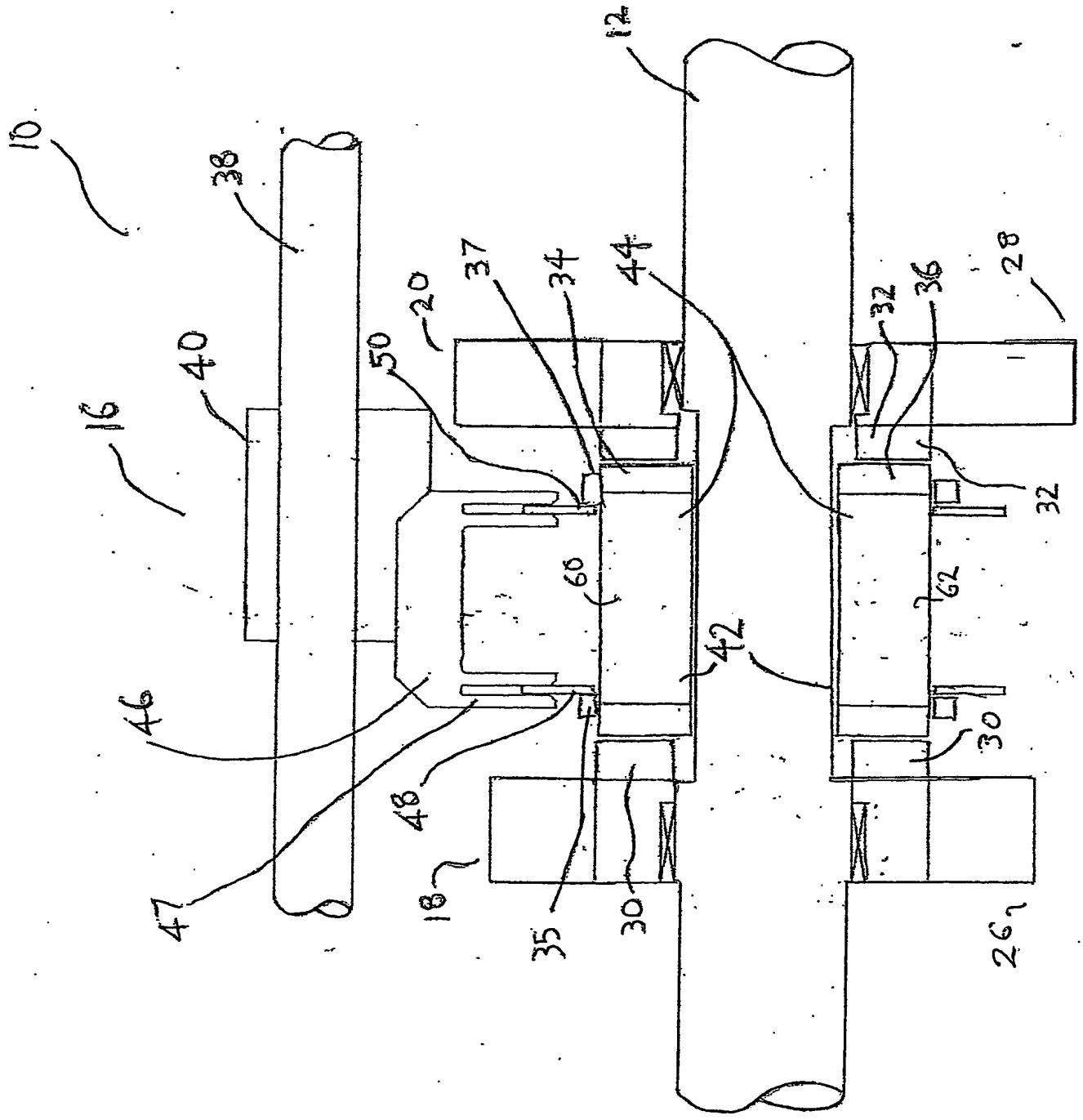
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Fig 3

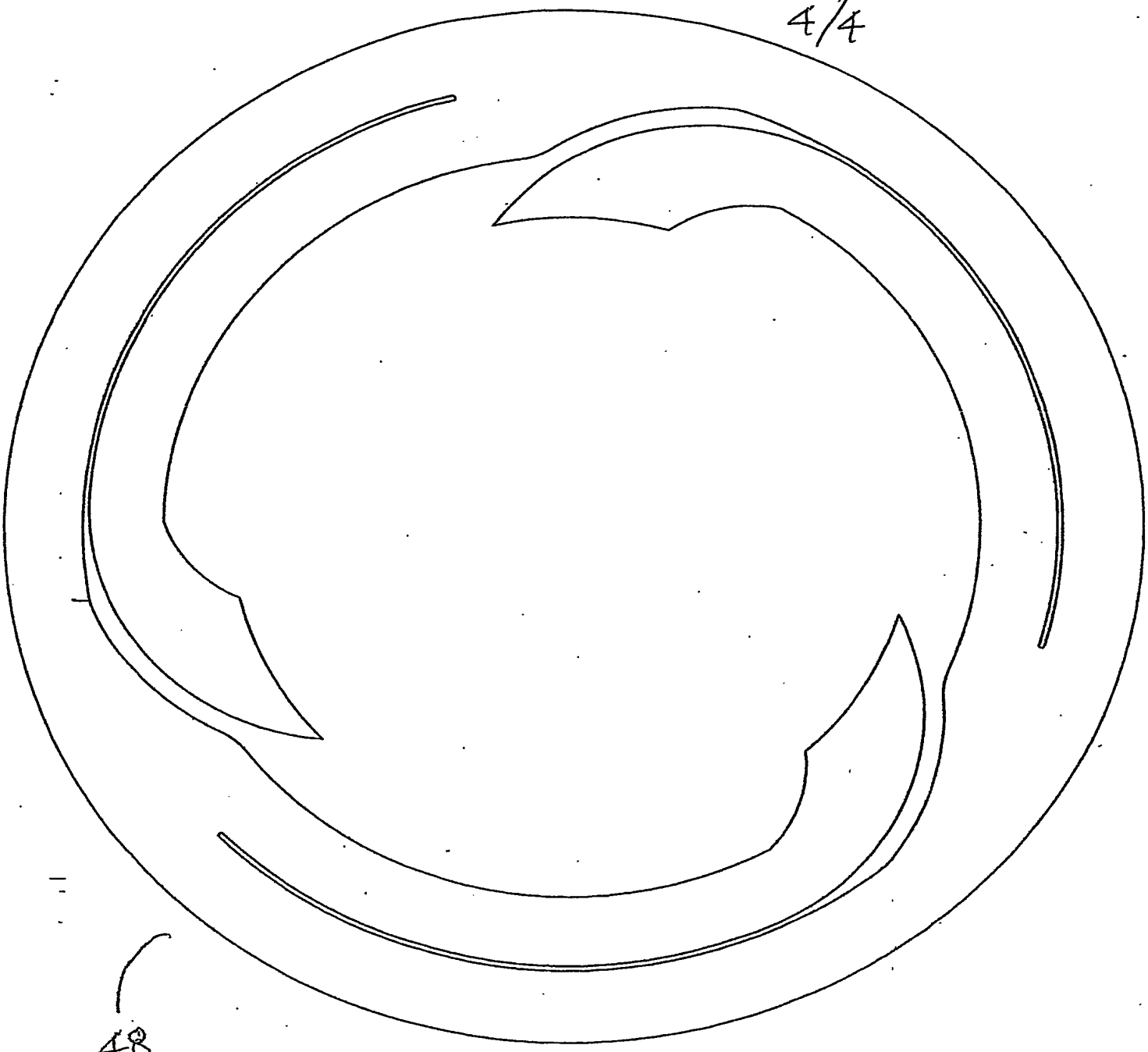

Fig 4

INTERNATIONAL SEARCH REPORT

GB2004/001976

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F16H63/30 F16D23/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F16H F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 01/29440 A (PRELOAD INTERNAT LTD ; MARTIN WILLIAM WESLEY (GB)) 26 April 2001 (2001-04-26) cited in the application the whole document	1-5, 7-10,12, 21
Y		14-17,22
A		6,11,13, 18-20
Y	DE 23 24 801 A (THOMAS DALTON ADMIRAL) 6 December 1973 (1973-12-06) figure 13	14-17
Y	DE 14 50 177 B (RENAULT) 23 April 1970 (1970-04-23) figure 1	22

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 September 2004	28/09/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Hassiotis, V

INTERNATIONAL SEARCH REPORT

GB2004/001976

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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